GEOMAGNETIC ACTIVITY AND SOLAR M-REGIONS FOR THE CURRENT EPOCH OF THE SUNSPOT MINIMUM

J. N. TANDON

DEPARTMENT OF PHYSICS, UNIVERSITY OF DELHI, DELHI

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ABSTRACT. The analysis of geomagnetic activity has been made for the period 1950-54 and four sequences of annual variations have been detected. It has been shown that the most predominant effect of M-regions is observable only on particular dates separated at an interval of 27 days. In the last section the possibility of the association of M-regions with various solar features has been discussed and it is found that they can be identified with unipolar magnetic regions which may also be the seat of low coronal line intensities.

I. INTRODUCTION

The moderate geomagnetic storms showing 27-day recurrence tendency were supposed to last for the duration of seven to eight rotations only, forming the so called M-sequences, due presumably to the existence of some M-regions (Bartels, 1932). In a recent paper Naqvi and Bhargava (1954, hence forth refrred to as Paper I) have shown the presence of two very long M-sequences, showing annual variations against the six-monthly variations discussed by Bartels. The most probable cause of this annual variation was described to be tilt of solar axis of rotation to the ecliptic and is referred to as "axial hypothesis" in Paper I. In a more recent paper Naqvi and Tandon (1955) have given the results of the analysis of geomagnetic activity for the period 1930-34 and detected three very long se-quences showing annual variations. The longest sequence in this period lasts for about 58 rotations.

In the present paper, the sample of data for the period 1950-54 has been re-examined and four sequences (A, B, A_1, and B_1) have been obtained. The first two sequences are essentially of the same nature as referred to in Paper I while the last ones apparently show six-monthly variations. A close examination of A_1 and B_1 sequences has indicated the presence of the real annual variation and thus strongly favours the axial hypothesis which is also supported by the analysis of geomagnetic activity in regard to their assosiation with regions of coronal emission lines (Bell and Glazer, 1954). It has further been shown that the *most predominent effect of M-regions is observable on particular dates which are separated from one another at an interval of 27 days and that these regions live for* *about 30-50 rotations.* In the last section the possibility of identifying these *M*-regions with various solar features has been discussed and is shown that *M*-regions can be identified with the newly observed 'unipolar' magnetic regions.

II. ANALYSIS OF THE GEOMAGNETIC ACTIVITY

(a) *Method of Analysis* :—The three days running means of the daily *C*-figure of the geomagnetic activity is plotted for the period 1950-54 and the sequences of recurrent activity with a period of 27 days are constructed. The sequences are considered to be continuing during the next year, even after six or seven rotations of low activity, if the high activity repeats during that year. It has been verified that this process of three days running means essentially does not affect the variation of the activity within a sequence except slightly reducing the large maxima and slightly increasing the minima or shifting the date of maximum activity by one day on either side.

To study the variation of geomagnetic activity within a particular sequence five different sets of curves are plotted as follows;

(i) *Mean day activity curve*: The *C*-figure after every 27 days starting from certain selected dates, determined on the basis of the plots of the three days running means of the daily *C*-figure. These curves show a well marked periodicity of annual nature.

(ii) The *C*-figure after every 27 days starting one day earlier than in the case of the mean day activity curve.

(iii) The *C*-figure after every 27 days starting one day later than in the case of the mean day activity curve.

The purpose of the second and the third set of curves is to check the appropriateness of the particular dates chosen for the first set. The periodicity in the later sets is found to be less marked than in the mean day activity curves. This was expected in view of the fact that moderate geomagnetic storms last for for about 2-4 days only. To illustrate this departure we consider *A*-sequence in figure 1 which shows the mean day activity curve by thick lines while the second and the third set of curves by thin lines superimposed over the thick curve. A close examination of this figure clearly indicates the departure in the periodicity of the second and the third set of curves from the mean day activity curves, referred to as above.

(iv) *Mean activity curve*: The three day running means centered around the selected dates used in the mean day activity curves at an interval of 27 days ; this, indeed, is a composite effect of the first, the second and the third set of curves and shows a well marked periodicity as good as in the case of the first set of curves.

There are theoretical difficulties to account for the behaviour of the set of curves 2 and 3 and the mean day activity curves as regards to their periodicity and can probably, be explained on the assumption of narrow beam of particles. We will not enter into the cause of such peculiar behaviour of these sets of curves because we have not investigated the theories of magnetic storms here. The same properties of M-storms have also been found by the author in the analysis of the geomagnetic activity for the period 1920-24 and 1930-34.

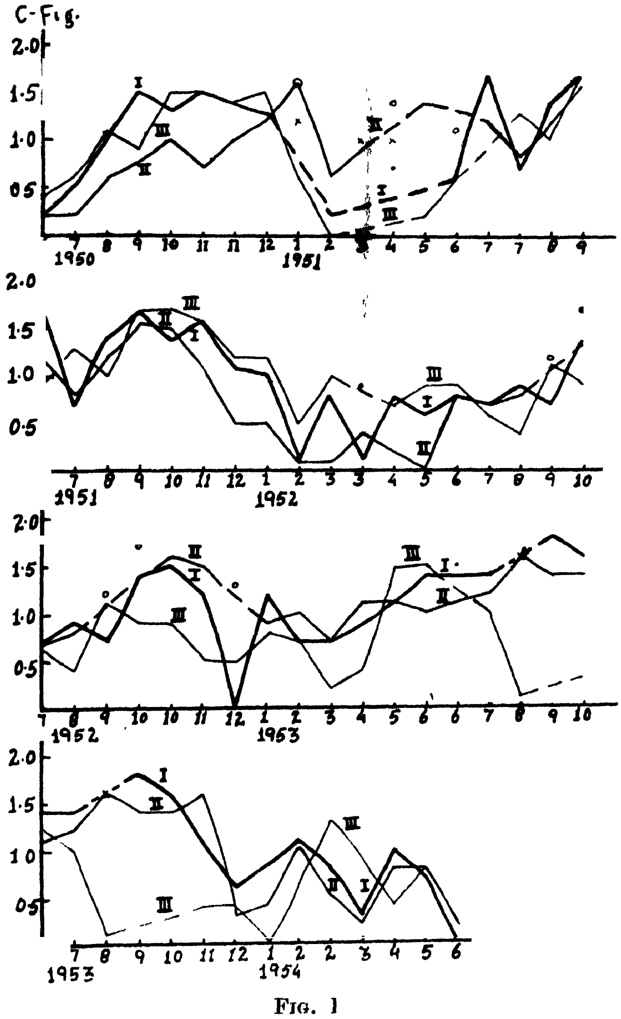

Fig. 1

Curve I—(Thick line)—The mean day activity curve.
Curve II—(Medium thick line)—The one day earlier curve.
Curve III—(Thin line)—The one day later curve.
Cross—Values of C-fig. for the S.S.C type storm for curve I.
Circle—Values of C-fig. for the S.S.C. type storm for curve II.
Dot—Values of C-fig. for the S.S.C. type storm for curve III.

(v) *The maximum activity curve*: This set of curves is plotted by picking the highest value of C-figure around the selected dates with a departure of only

± 1 day from the 27 days periodicity. The annual variation of the sequence is sufficiently marked but not as good as in the case of the mean day activity curves. This set of curves is essentially the same as discussed in Paper I, differing only in minor details which are given below along with the discussion of A and B se-quences.

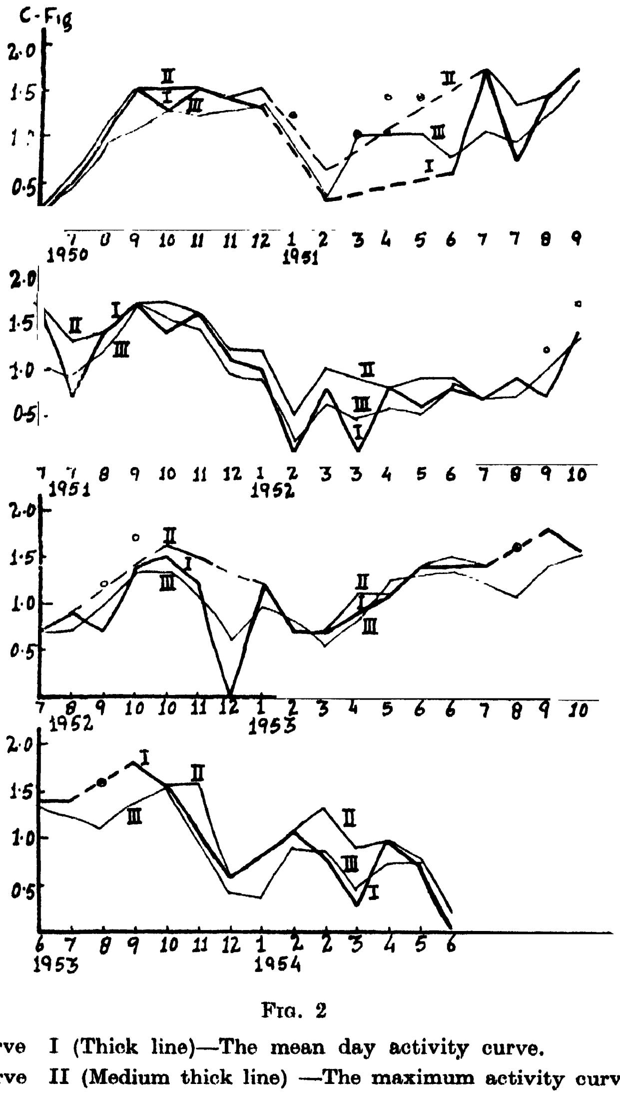

FIG. 2

Curve I (Thick line)—The mean day activity curve.
Curve II (Medium thick line) —The maximum activity curve.
Curve III (Thin line)—The mean activity curve.
Cross—Values of C-fig. for the S.S.C. type storms for curve I.
Circle—Values of C-fiig. for the S.S.C. type storms for curve II.

(b) *Discussion of Sequences*:—The data for the analysis have been taken from the Journal of Geophysical Research. The sudden commencement type of storms considered here are those marked as S.S.C. type of storms. This analysis of geomagnetic activity for the period Jan. 1950 to June 1954 has led to the four sequences (called A, B, A_1 and B_1) showing annual variations. The A and B sequences are essentially of the same nature as discussed in Paper I, while A_1

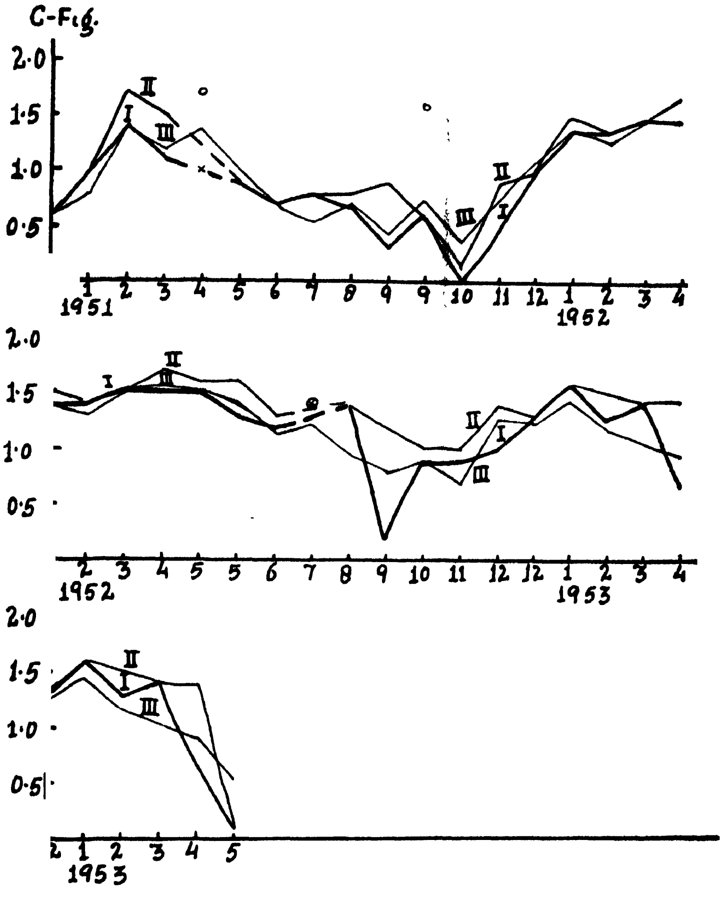

FIG. 3

Curve I (Thick line)—The mean day activity curve.

Curve II (Medium thick line)—The maximum activity curve.

Curve III (Thin line)—The mean activity curve.

Cross—Values of C-fig. for the S.S.C. type storms for curve I.

Circle—Values of C-fig. for the S.S.C. type storms for curve II.

and B_1 sequences refer to the new sequences which apparently show six-monthly variation and are discussed in detail below. These four sequences are shown in figures 2 to 5 respectively. The days and months in these figures are represented by the numerical numbers from 1 to 12, corresponding to the activity belonging to the months from January to December, respectively. The mean activity and maximum activity curves are shown superimposed over the mean day activity curves in these figures. The data for these curves are tabulated in Tables II to V. Column 1 gives the dates of the sequences while columns 2 and

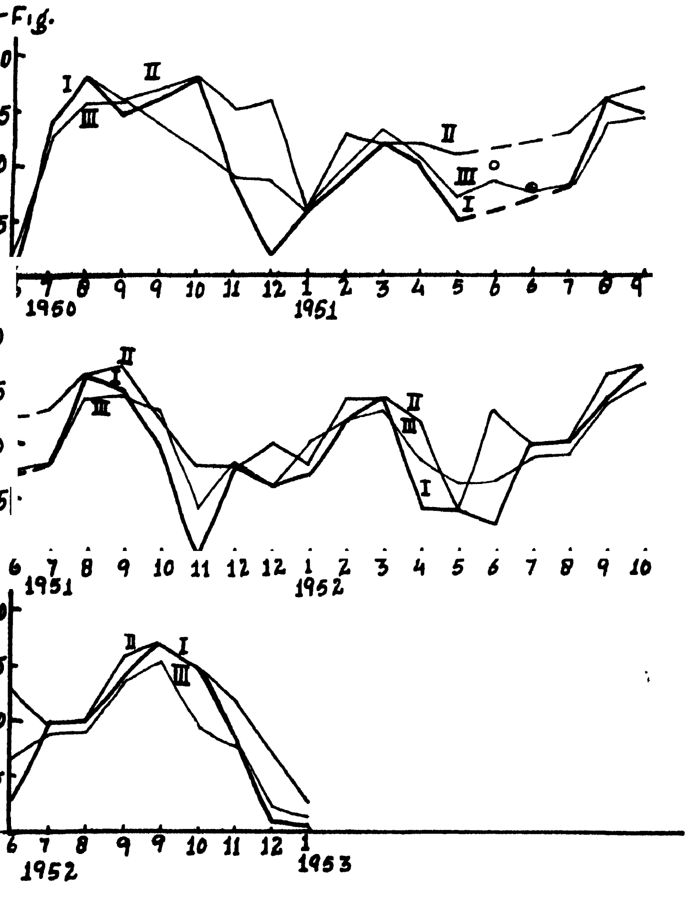

Fig. 4

Curve I (Thick line)—The mean day activity curve.
Curve II (Medium thick line)—The maximum activity curve.
Curve III (Thin line)—The mean activity curve.
Cross—Values of C-fig. for the S.S.C. type storms for curve I.
Circle—Values of C-fig. for the S.S.C type storms for curve II.

4 represent the values of *C*-figures for the mean day activity and maximum activity curves. Column 3 gives the 3-day running means of the *C*-figures for the mean activity curves and in column 5 the interval of recurrence for the maximum activity curves is given. In the last column of Tables II and IV, the dates of *M*-sequences of Bell and Glazer are given for comparison. To summarize these results

we have given the approximate dates of beginning and of the end, the number of rotations and the probable latitude of the M-regions in Table I. The longitude

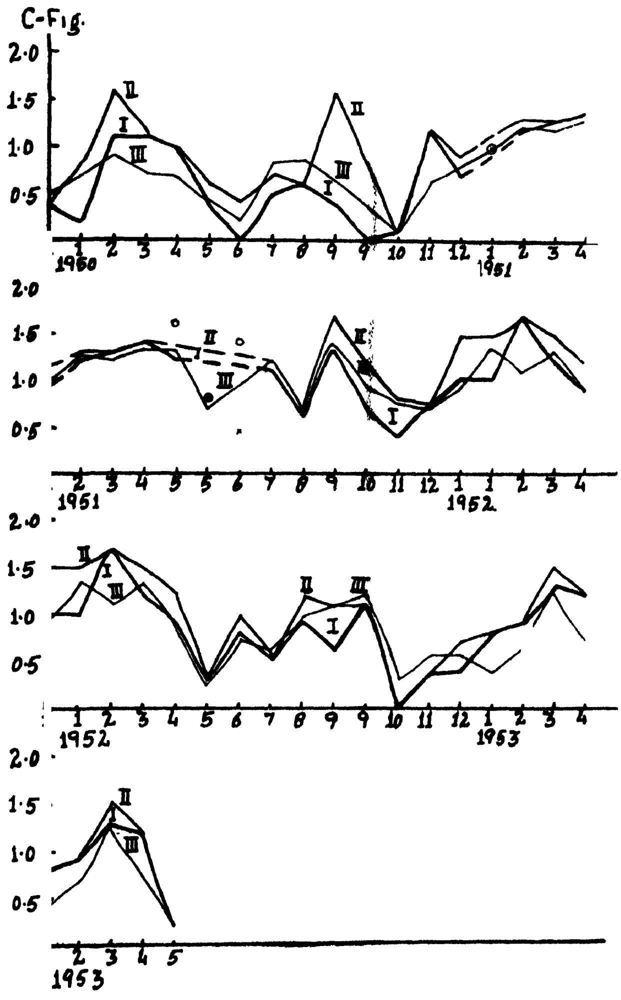

FIG. 5

Curve I (Thick line)—The mean day activity curve.
Curve II (Medium thick line)—The maximum activity curve.
Curve III (Thin line)—The mean activity curve.
Cross —Values of C-fig. for the S.S.C. type storms for curve I.
Circle—Values of C-fig. for the S.S.C. type storms for curve II.

difference of the A_1, the A and the B M-regions (called after the respective sequences) with respect to the B_1 M-region are about 27°, 80° and 175° respectively.

TABLE I

	A-sequence	B-sequence	A_1-sequence	B_1-sequence
The approximate date of beginning	19 Jun. 1950	1 Jan. 1951	15 Jun. 1950	2 Jan. 1950
The approximate date of end	—	14 May 1953	15 Jan. 1953	1 May 1953
Month of max. activity Month of min. activity	Sept. Marc.	Mar. Sept.	Sept. Mar.	Mar. Sept
No. of rotations	54	32	35	45
Periodicity	12 month	12 month	12 month	12 month
Position of M-region(Latitude)	above 7°.2.N.	below 7°.2.S.	above 7°.2.N.	below 7°.2.S.

A and B sequences :—The A and B sequences are supposed to begin respectively from the 19th June 1950 and the 1st Jan. 1951 rather than from the 15th June 1950 and 22nd Nov. 1951 as reported in Paper I, where the authors have departed by ± 3 days from the mean day activity by taking consecutive rotations of 26 or 28 days and hence the beginning part of their A sequence belongs to our A_1-sequence. In the present analysis we have restricted ourselves to a ± 1 day shift only from the dates chosen for the mean day activity curve. The two sequences last for about 54 and 32 rotations respectively. The M-regions (A and B) responsible for these sequences are found to be separated with a difference of about 95° in longitude and lie above 7°.2 and below 7°.2 in the northern and southern solar hemispheres respectively.

TABLE II

S. No.	Date	C-fig.	Three times the values of the running mean	Max. C-fig.	Interval days	Date for Bell and Glazer sequences.
1	19– 6–50	0.2	0.8			
2	16– 7–50	0.5	1.3	0.6	26	
3	12– 8–50	1.0	2.7	1.1	27	
4	8– 9–50	1.5	3.2	1.5	28	
5	5.10.50	1.3	3.8	1.5	26	
6	1–11–50	1.5	3.7	1.5	27	
7	28–11–50	1.4	3.8	1.4	27	
8	25–12–50	1.3	4.0	1.5	27	
9	21– 1–51	1.2	3.4	1.2	28	
10	17– 2–51	0.3	0.9	0.6	28	
11	16– 3–51	1.0	2.9	1.0	26	
12	12– 4–51	1.0	3.1	1.4	28	
13	9– 5–51	1.4	3.0	1.4	27	
14	5– 6–51	0.6	2.3	1.1	27	

TABLE II (contd.)

S. No.	Date	C-fig	Three times the values of the running mean	Max C-fig	Interval days	Date for Bell and Glazer sequences
15	2- 7-51	1.7	3.1	1.7	26	1- 7-51[c]
16	29- 7-51	0.7	2.8	1.3	26	28- 7-51
17	25- 8-51	1.4	3.6	1.4	28	24- 8-51
18	21- 9-51	1.7	5.0	1.7	27	20- 9-51
19	18-10-51	1.4	4.6	1.7	26	17-10-51
20	14-11-51	1.6	4.3	1.6	27	12-11-51
21	11-12-51	1.1	2.8	1.2	27	8-12-51
22	7- 1-51	1.0	2.7	1.2	27	
23	3- 2-52	0.1	0.7	0.5	27	
24	1- 3-52	0.8	1.9	1.0	27	
25	28- 3-52	0.1	1.4	0.9	27	
26	24- 4-52	0.8	1.7	0.8	28	
27	21- 5-52	0.6	1.5	0.9	26	
28	17- 6-52	0.8	2.5	0.9	27	
29	14- 7-52	0.7	2.0	0.7	28	
30	10- 8-52	0.9	2.1	0.9	27	
31	6- 9-52	0.7	2.0	1.2	28	7-9-52[f]
32	3-10-52	1.4	4.0	1.7	27	3-10-5
33	30-10-52	1.5	4.0	1.6	27	30-10-52
34	26-11-52	1.2	3.2	1.5	27	26-11-52
35	23-12-52	0.0	1.8	1.3	27	24-12-52
36	19 1-53	1.2	2.9	1.2	26	
37	15- 2-53	0.7	2.4	1.9	28	
38	14- 3-53	0.7	1.6	0.7	27	
39	10- 4-53	0.9	2.4	1.1	27	10-4-53[h]
40	7- 5-53	1.1	3.7	1.1	27	6 5-53
41	3- 6-53	1.4	3.9	1.4	26	2- 5-53
42	30- 6-53	1.4	4.0	1.5	27	29- 6-53
43	27- 7-53	1.4	3.6	1.4	27	26- 7-53
44	23- 8-53	1.6	3.3	1.6	27	23- 8-53
45	19- 9-53	1.8	4.2	1.8	27	19- 9-53
46	16-10-53	1.6	4.6	1.6	27	15-10-53
47	12-11-53	1.	3.	1.6	27	
48	9-12-53	0.6	1.3	.06	27	
49	5- 1-54	0.8	1.2	0.8	27	
50	1- 2-54	1.1	2.7	1.1	27	
51	28- 2-54	0.8	2.6	1.3	26	
52	27- 3-54	0.3	1.4	0.9	26	
53	23- 4-54	1.0	2.2	1.0	29	
54	20- 5-54	0.7	2.3	0.8	27	
55	16- 6-54	0.0	0.4	0.2	26	

TABLE III

S. No.	Date	C.-fig.	Three times the values of running mean	Max. C. fig.	Interval days
1	1– 1–51	0.6	1.8		
2	28– 1–51	1.0	2.4	1.0	27
3	24– 2–51	1.4	4.1	1.7	26
4	23– 3–51	1.1	3.6	1.5	27
5	19– 4–51	1.0	4.1	1.7	27
6	16– 5–51	0.9	2.9	0.9	28
7	12– 6–5	0.7	2.1	0.7	27
8	9– 7–51	0.8	1.7	0.8	27
9	5– 8–5	0.7	3.1	0.8	26
10	1– 9–5	0.3	1.3	0.9	27
11	28– 9–51	0.6	2.3	1.6	27
12	25–10–51	0.0	1.1	0.	27
13	21–11–51	0.5	2.3	0.9	27
14	18–12–51	1.0	3.2	1.0	27
15	14– 1–52	1.4	4.	1.5	27
16	10– 2–52	1.4	3.9	1.4	28
17	8– 3–52	1.5	4.5	1.5	27
18	4– 4–51	1.5	4.6	1.7	26
19	1– 5–52	1.5	4.5	1.6	27
20	28– 5–52	1.3	4.2	1.6	27
21	24– 6–52	1.	3.4	1.3	27
22	21– 7–52	1.4	3.6	1.4	28
23	17– 8–52	1.4	2.8	1.	27
24	13– 9–52	0.2	2.4	1.2	27
25	10–10–52	0.9	2.7	1.0	27
26	6–11–52	0.9	2.1	1.0	27
27	3–12–52	1.0	3.8	1.4	27
28	30–12–52	1.3	3.7	1.3	26
29	26– 1–53	1.6	4.3	1.6	27
30	22– 2—52	1.3	3.5	1.5	28
31	21– 3–53	1.4	3.2	1.4	28
32	17– 4–53	0.7	2.8	1.4	26
33	14– 5–53	0.1	1.6	0.1	28

A_1 and B_1 Sequences :—The A_1 and B_1 sequences begin from the 15th June 1950 and the 2nd January, 1950 respectively. The difference in longitude between the two M-regions ((A_1 and B_1) responsible for these sequences is about 27°. The two M-regions are to be situated above 7.2° and below 7.2° in the northern and the southern solar hemisphere respectively.

TABLE IV

S. No.	Date	C-fig.	Three times the values of the running mean	Max. C-fig.	Interval days	Date for Bell and Glazer sequences
1	15- 6-50	0.0	0.6			
2	12- 7-50	1.4	3.8	1.4	27	11- 7-50
3	8- 8-50	1.8	4.7	1.8	27	7- 8-50
4	4- 9-50	1.5	4.7	1.6	28	3- 9-50
5	1-10-50	1.6	4.1	1.7	27	1-10-50
6	28-10-50	1.8	3.5	1.8	26	28-10-50
7	24-11-50	0.9	2.7	1.5	28	25-11-50
8	21-12-50	0.2	2.6	1.6	27	22-12-50
9	17- 1-51	0.5	1.8	0.5	27	
10	13- 2-51	0.9	2.9	1.3	26	
11	12- 3-51	1.2	4.0	1.2	27	
12	8- 4-51	1.0	3.2	1.2	27	
13	5- 5-51	0.5	2.2	1.1	27	
4	1- 6-51	1.0	2.6	1.0	28	
15	28- 6-51	0.8	2.3	0.8	27	
16	25- 7-51	0.8	2.4	1.3	28	
17	21- 8-51	1.6	4.2	1.6	26	
18	17- 9-51	1.5	4.3	1.7	26	
19	14-10-51	1.0	3.9	1.2	27	
20	10-11-51	0.0	1.2	0.8	27	
21	7-12-51	0.8	2.5	0.8	28	
22	3- 1-52	0.6	1.8	1.0	28	
23	30- 1-52	0.7	3.0	0.8	27	
24	26- 2-52	1.2	3.6	1.4	27	
25	24- 3-52	1.4	3.9	1.4	26	
26	20- 4-52	0.4	2.6	1.2	26	
27	17- 5-52	0.4	1.9	0.4	28	
28	13- 6-52	0.3	2.0	1.3	28	
29	10- 7-52	1.0	2.6	1.0	26	
30	6- 8-52	1.0	2.7	1.0	27	
31	2- 9-52	1.4	4.1	1.6	26	
32	29- 9-52	1.7	4.6	1.7	28	
33	26-10-52	1.5	2.9	1.5	27	
34	22-11-52	0.9	2.4	1.2	26	
35	19-12-52	0.1	0.8	0.7	27	
36	15- 1-53	0.1	0.5	0.3	26	

TABLE V

S. No.	Date	C-fig.	Three times the values of the running mean	Max. C-fig.	Interval days
1	2- 1-50	0.4	1.5		
2	29- 1-50	0.2	2.0	0.8	26
3	25- 2-50	1.1	2.7	1.6	27
4	24- 3-50	1.1	2.1	1.1	28
5	20- 4-50	1.0	2.0	1.0	27
6	17- 5-50	0.4	1.2	0.6	26
7	13- 6-50	0.0	0.6	0.4	27
8	10- 7-50	0.5	2.5	0.7	27
9	6- 8-50	0.6	2.6	0.6	28
10	2- 9-50	0.4	2.0	1.6	28
11	29- 9-50	0.0	1.1	0.8	27
12	26-10-50	0.1	0.3	0.1	26
13	22-11-50	1.2	1.9	1.2	27
14	19-12-50	0.7	2.4	0.9	26
15	15- 1-51	1.0	2.8	1.0	28
16	11- 2-51	1.2	3.7	1.3	28
17	10- 3-51	1.3	3.6	1.3	26
18	6- 4-51	1.4	3.9	1.4	27
19	3. 5-51	1.2	3.9	1.6	26
20	30- 5-51	0.8	2.1	0.8	28
21	26- 6-51	0.6	2.8	1.4	26
22	23- 7-51	1.1	3.6	1.2	27
23	19- 8-51	0.6	2.1	0.6	28
24	15- 9-51	1.3	4.1	1.7	28
25	12.10-51	0.7	2.8	1.2	27
26	8-11-51	0.4	2.2	0.8	27
27	5-12-51	0.7	2.1	0.7	26
28	1- 1-52	1.0	2.7	1.5	26
29	28- 1-52	1.0	4.0	1.5	27
30	24- 2-52	1.7	3.3	1.7	28
31	22- 3-52	1.2	4.0	1.5	28
32	18- 4-52	0.9	2.7	1.2	27
33	15- 5-52	0.3	0.8	0.3	26
34	11- 6-52	0.8	2.2	1.0	26
35	8- 7-52	0.5	1.9	.05	28
36	4- 8-52	0.9	2.9	1.2	26
37	31- 8-52	0.6	3.3	1.1	27
38	27- 9-52	1.1	3.6	1.1	27
39	24-10-52	0.0	0.9	0.0	27
40	20-11-52	0.4	1.7	0.4	38
41	17-12-52	0.4	1.7	0.7	26
42	18- 1-53	0.8	1.2	0.8	26
43	9- 2-53	0.9	1.9	0.9	27
44	8- 3-53	1.3	3.7	1.5	28
45	4- 4-53	1.2	2.2	1.2	26
46	1- 5-53	0.2	0.9	0.2	27

The study of these sequences on the basis of the maximum activity curves shows marked six-monthly periodicity which is not so predominent, if one considers the mean day activity curves. It is quite apparent from the study of the A and B-sequences of the present analysis (see figures 1, 2 and 3) that the main features of the M-sequences are markedly seen on the mean day activity curves. This effect has also been observed by the author, while analysing the samples of data for the two other periods viz. 1920-24 and 1930-34. Further, it is seen that the secondary maxima of the two sequences (A_1 and B_1) are not as much pronounced as the primary ones. From these one can very well judge the reality of the annual variations of these sequences.

Keeping in view the fact that the moderate geomagnetic storms last for about 2 to 4 days, this six-monthly periodicity of A_1 and B_1 sequences can very well be be accounted for from the hypothesis of Bhargava and Naqvi (1954, see also Paper I) by assuming that the two M-regions responsible for these sequences are lying in the opposite hemispheres and have a longitude difference of about 27°. The A_1 and the B_1 M-regions were active for about 35 and 45 rotations respectively.

III. SOLAR FEATURES AND M-REGIONS

The annual variation of geomagnetic activity for the period 1930-34 (Naqvi and Tandon) and 1950-54 (Paper I) related to solar M-regions has given some clue to the probable position of these regions. The cause associated with these annual variations viz., the tilt of solar axis of rotation to the ecliptic has already been discussed in detail in Paper I (see also Bhargava and Naqvi 1954). This explanation (axial hypothesis) further receives support from the study of geomagnetic variation associated with regions of weak coronal line emission (Bell and Glazer, 1954).

Several attempts have been made to identify the M-regions on the basis of visible phenomena occuring in the solar corona and on the disc. There are two different views, one relating the source of the M-regions responsible for the moderate geomagnetic storms with the solar ultraviolet radiations and the other relating them with the solar corpuscular radiations. Wulf and Nicholson (1948) and Richardson (1951) considered the first possibility, by relating the M-regions activity with the bright hydrogen and calcium flocculi which emit ultraviolet radiations. It has now been tentatively decided that these M-sequences are due to the effect of the compuscular radiation coming from some hypothetical M-regions. Allen (1944) and Kiepenheur(1952) ascribed the M-regions to an increase in the filament area near the central meridian of the sun, The present analysis indicates that the storms related to coronal streamer observed at the eclipse of 25th Feb. 1952 (Von Kluber, 1952) and discussed by Kiepenheur, do not belong to any of the four sequences considered above.

Maxwell (1952) has discussed the first few rotations of A_1 sequence which also forms a part of the A-sequence of Paper I. He ascribed this M-sequence to a coronal region overlying a sunpot group with intense radio emission in the metre wave band. The M-region associated with A_1 sequence lie in the northern hemisphere while this sunspot group is situated at a latitude of 18° south.

Waldmeier (1939, 1946, 1950) has found that in some cases, M-regions may be identified with the solar C-regions—those small areas of the corona associated with a brightening of the green coronal line at $\lambda = 5303\text{Å}$—and he has also shown that the M-regions and the C-regions have the same statistical properties. Shapely and Roberts (1946) have also associated the C-region with M-regions. Trotter and Roberts (1952) and Muller (1953) have also reached the same conclusions for the current epoch of the sunspot minimum.

On the other hand, Bell and Glazer have reported nine M-sequences (a to i) during the years 1950-53 and associated the M-storms of these sequences with the regions of weak coronal line ($\lambda = 5303\mathring{A}$) intensities located on the same side of the solar equator as the earth. These conclusions were drawn previously by Bruzek (1952) and Smith (1952).

While comparing the M-sequences of Bell and Glazer with our four sequences we find that their M-sequences (c. f and h) forms the part of our A-sequence and one of them (a) belongs to our A_1 sequence (see Tables II and IV). Thus it is clear that the A-sequence is mostly associated with the regions of weak coronal line intensities.

In the recent papers Babcock and Babcock (1955, a, b) have reported the presence of unipolar magnetic (UM) regions over the solar disc and associated one of them* with the M-sequence and with the regions of weak coronal line (5303) intensities (1955b). The M-sequence considered by them forms a part of our A-sequence which is also associated with regions of weak 5303 intensities. It has further been found that there is only one UM-region quite active during the period 1953 and is situated at a latitude of about 15°N. From our analysis it is also clear that there is only one M-region (A) which was active during the year 1953 while the rest (B, A_1 and B_1) M-regions have died early in 1953 and further this M-region should be situated at a latitude above 7°.2N. Thus one can very well conclude that the M-regions which are associated with regions of weak 5303 intensities may be identified with the Babcock's UM-regions. To confirm our findings we hope to investigate the behaviour of others M-sequences (B, A_1 and B_1) in regard to their association with UM-regions and with the regions of weak 5303 intensities as soon as the data will be available to us.

The emission of particles from the M-regions is supposed to be associated with spicule activity. Rush and Roberts (1954) suggested a mechanism in which they considered the cone of the particles to be formed due to the magnetic field of the

*The author is grateful to Dr. H. W. Babcock for informing him, in advance of the dates when this, most prominent, UM-regions of 1953 crossed the central meridian.

sunspot groups. Babcock and Babcock are of the opinion that the ejection of the particles from the M-regions due to spicule activity is associated with the magnetic field of the UM-regions. The particles will come out more or less radially from these regions, without pronounced collisions, and hence will not be strong radio flux generators. As far as the author is aware there are not much evidences about the M-sequences associated with strong radio emission. However, Das and Bhargava (1953) have shown such a possibility by accounting the short duration radio noise of Aug. 24 and Aug. 25, 1953 with the M-storms of Naqvi and Bhargava. On the basis of our analysis, we can postulate that this short duration radio noise and also the one observed on Aug. 29, 1953 may not be associated with M-region and it needs further investigations before one can really associate M-regions with radio flux emission. Hence in our opinion the UM-regions, unassociated with radio noise, may turn out to be identical with the M-regions which may further be associated with regions of weak 5303 intensities. Further evidences, in its support have very recently been put forward by Simpson, Babcock and Babcock (1955). They have associated the UM-regions with changes of primary cosmic ray intensities and also with the recurrent geomagnetic storm and have proposed a mechanism to account for such peculiar behaviours of UM-regions. The unpublished results of an independent study of the magnetic maps of solar disc (Magnetogram records of H.W. and H.D. Babcock) by Miss Marion B. Wood of High Altitude Observatory, Colorado, have recently been brought to the notice of the author by Dr. Walter Orr Roberts. They appear to differ from our findings of UM-regions.

In conclusion, we can only say that there is a large probability of identifying M-regions with these newly observed UM-regions but the confirmation of these results needs further observational data.

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